

**Before the
Federal Communications Commission
Washington, DC 20554**

In the Matter of

Unlicensed Use of the 6 GHz Band

Expanding Flexible Use of the Mid-Band
Spectrum Between 3.7 GHz and 24 GHz

ET Docket No. 18-295

GN Docket No. 17-183

Reply Comments of RigNet Satcom, Inc.

RigNet Satcom, Inc. ("RigNet") submits these comments in response to the above-captioned Notice of Proposed Rulemaking¹ and as a supplement to prior comments submitted on December 10, 2018.

RigNet believes that opening the 6 GHz band to unlicensed use in the Gulf of Mexico would create an unreasonable risk of interference to existing critical communications systems. Therefore, RigNet urges the Federal Communications Commission ("FCC") to exclude the Gulf of Mexico from any expanded unlicensed use of 6 GHz. RigNet further urges the FCC to provide greater protections for backhaul systems used to carry traffic from the Gulf of Mexico through the 12-mile coastal zone and onto the beach.

¹ See *Unlicensed Use of the 6 GHz Band*, Notice of Proposed Rulemaking, ET Docket No. 18-295, *et al.* (October 23, 2018)(hereafter "6 GHz NPRM").

I. Gulf of Mexico Infrastructure

RigNet's operates a WiMax access network in the Gulf of Mexico that spans an area of approximately 24,000 square miles. The backbone to the Wimax network consists of 93 point-to-point 6 GHz microwave links² that interconnect oil and gas platforms in the Gulf of Mexico. RigNet also operates 8 point-to-point beach-crossing links that that traverse uninhabited swamps between Venice, Louisiana and Galveston, Texas. (see Figure 1). Exhibit A shows a larger image of the map.

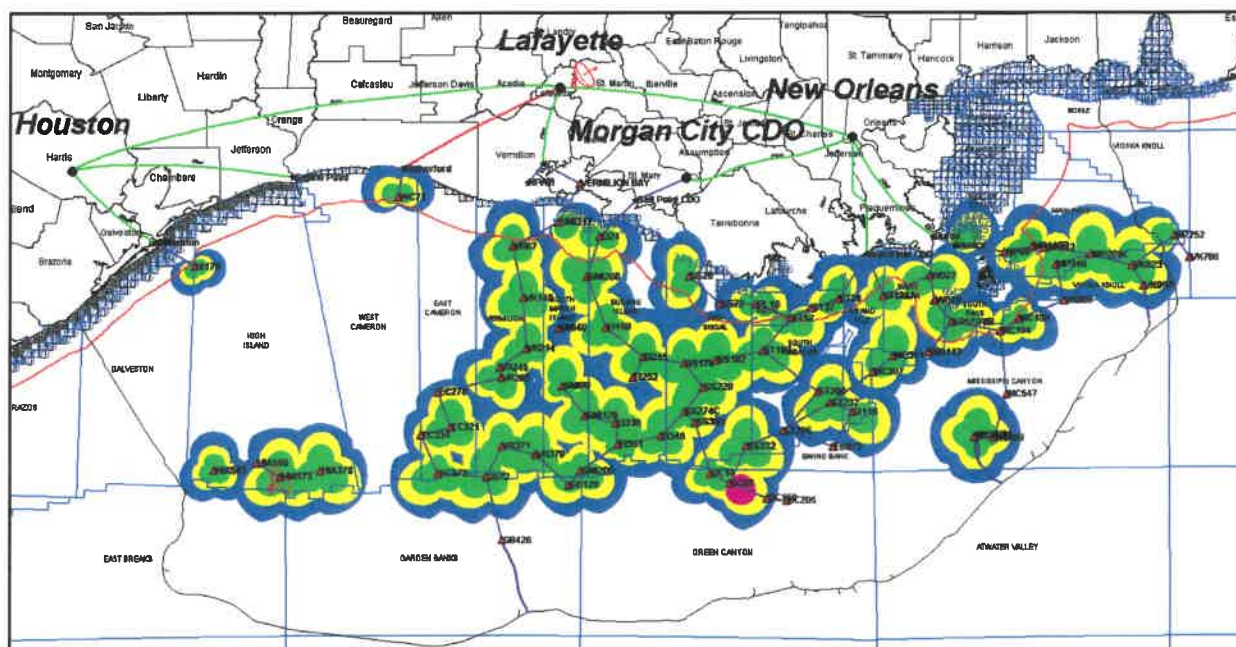


Figure 1. RigNet Wimax access Network operating on point-to-point 6 GHz backbone.

The network supports critical infrastructure in over 300 oil and gas platforms. Some platforms are manned while others unmanned. All platforms

² The vast majority of RigNet point-to-point 6 GHz links operate in the 6.1 and 6.7 GHz bands.

require uninterrupted communication that supports safety, emergency response, security, industrial controls, sensors, and monitoring, among other critical functions. Manned platforms depend on communications to enhance crew safety, sometimes up to 150 personnel per platform. Unmanned platforms must be constantly monitored for safety and security and a break in communications results in an immediate shutdown of production until communications can be restored.

II. Technical Details

The 6 GHz point-to-point paths carry high-capacity channels of 10, 30, and 60MHz with a maximum modulation of 4096QAM. The links interconnect oil and gas platforms using antennas installed on structures whose heights are barely sufficient to clear the first Fresnel zone. Because the transmission is over water, which is a reflecting media, the links are especially susceptible to harmful interference.

Vessels or platforms operating in the proposed unlicensed 6 GHz spectrum would have antenna heights similar to the antenna heights of RigNet's antennas. This means that antennas operating in the proposed unlicensed spectrum would likely be within the main lobe of the antenna pattern of RigNet's antennas. Any antennas operating in the proposed unlicensed spectrum, and within RigNet's line-of-sight, would cause harmful interference to RigNet's licensed links.

III. Calculations

As shown in the link budget calculations in Exhibit B, operation of unlicensed 6 GHz devices, even with a functioning Automatic Frequency Coordination (AFC) in place, would create a substantial link margin decrease which in turn would drastically affect quality of service. That is, link reliability of licensed 6 GHz systems, as well as average throughput, would drop substantially.

The calculations show how a 36 dBm interferer impacts a 6 GHz point-to-point microwave link between two RigNet callsigns: WPTH206 (ST52) and a potential receiver, WPND311 (ST100). These calculations assume that the interferer is located in the line-of-sight between the mentioned locations. The interferer is a 20 MHz carrier next to the RigNet path frequency channel.

Figure 2 below shows the point-to-point link between Gulf of Mexico blocks South Timbalier (ST52) and South Timbalier (ST100) (receiver). For purposes of the calculations, an interferer antenna has been placed at locations 5 miles, 10 miles, and 30 miles from ST100 as shown by black triangles (not to scale). This ST52-ST100 link was designed with a 1024QAM modulation and a 452 Mbps throughput. The link plain fade margin is 30 dB.

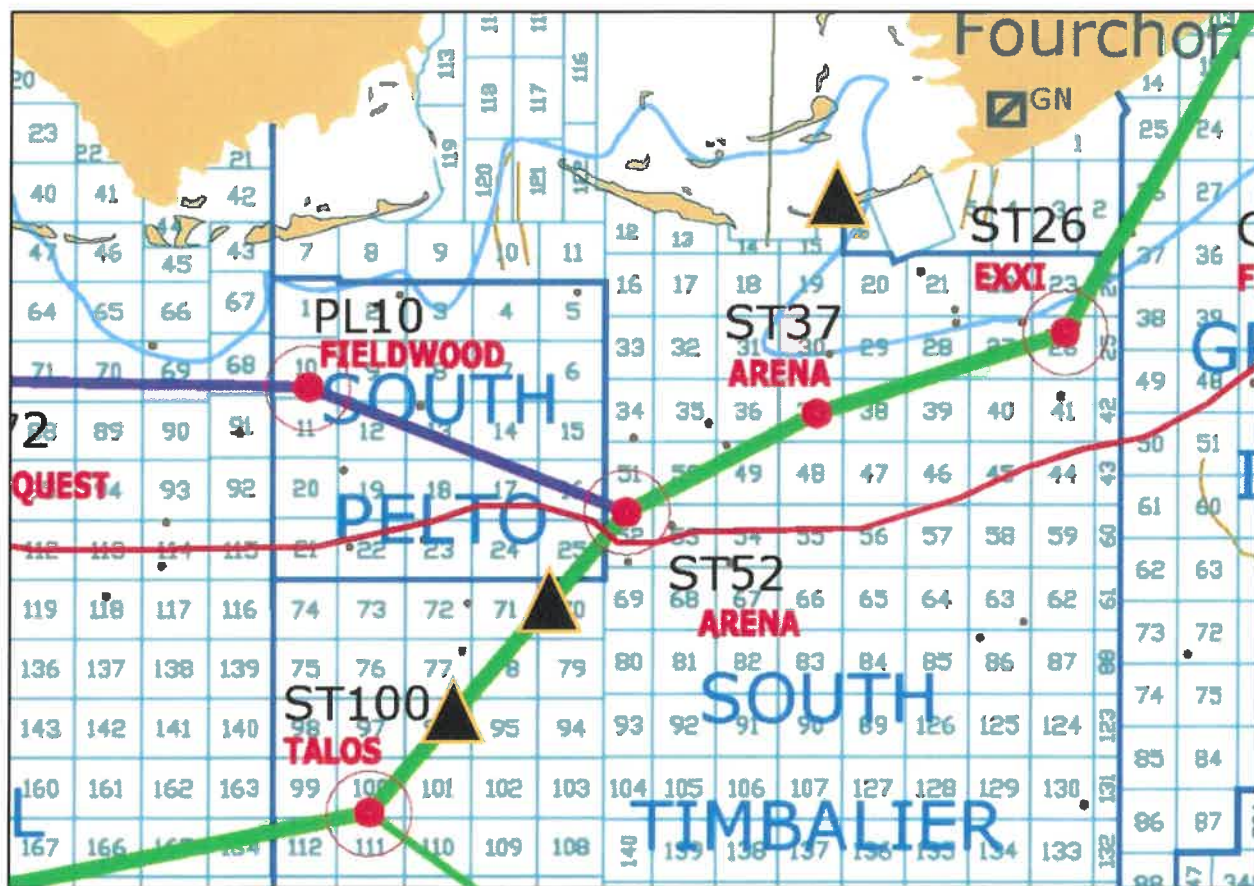


Figure 2. Gulf of Mexico 6 GHz Point-to-Point Microwave Links

If an interferer 6 GHz antenna is placed at 5 miles from ST100, the fade margin drops from 30 dB to 4.13 dB. This leads to a decrease in link reliability from 99.999% to 93.074%. The throughput drops by a factor of 5.3. (See details in Exhibit B)

If the interferer 6 GHz antenna is moved further away, at 10 miles from ST100, the fade margin drops from 30 dB to 12 dB. Consequently, the link availability drops from 99.999% to 98.923%. Also, the throughput drops by a factor of 2.7.

Finally, when the interferer antenna is moved 30 miles from ST100, (this is at the shoreline), there is still a negative impact to ST100. The flat fade margin drops from 30.0 dB to 27.39 dB and the availability drops from 99.999% to 99.996%.

These degradations are predictable and unacceptable. AFC and the protections suggested by the FCC will not ameliorate or mitigate the likelihood of interference because of the unique nature of the network and the performance of spectrum in a point-to-point system over the water. Moreover, the interference will be concentrated in the main lobe of each antenna along each link.

RigNet concurs with the technical analysis and conclusions of the Fixed Wireless Communications Coalition (FWCC) in that the premise that expanded unlicensed use in the Fixed Service bands would not cause interference is incorrect and without factual basis.³ Additionally, indoor restrictions and other mitigations will still cause unacceptable interference, especially at sea and for networks that require high reliability.⁴

The potential for life-threatening interference is easily remedied by excluding the Gulf of Mexico from any rulemaking expanding the unlicensed use of 6 GHz and providing a 35-mile exclusion zone around any network links within 12 miles of the coast.

³ Fixed Wireless Communications Coalition Ex Parte, October 2, 2018.

⁴ *Id.*


IV. Conclusion

Based on the calculations here discussed, a 6 GHz interfering transmitter would have a negative impact on RigNet's licensed 6 GHz links, even at 30 miles away. As such, RigNet urges the Commission to exclude the Gulf of Mexico from any rulemaking that would allow unlicensed 6 GHz devices. For the area within 12 miles of the coast, RigNet urges the Commission to prohibit any 6 GHz unlicensed transmitters within a 35-mile radius of any 6 GHz licensed link.

Pursuant to Section 1.1206 of the Commission's Rules, this letter is being filed electronically via the Electronic Comment Filing System in the above-referenced proceedings.

Respectfully submitted,

RIGNET SATCOM, INC.

By: 
Raul Magallanes, Assoc. General Counsel

Brad Eastman, General Counsel

James Arden Barnett, Jr, RDML USN (Ret)
Senior Vice President, Government Services

Exhibit B – Link Budgets

ST100-ST52A Path Before Interference



| | ST100 | ST52A |
|-------------------------------|----------------------|----------------------|
| Latitude | 28 40 24.80 N | 28 52 03.80 N |
| Longitude | 090 40 48.80 W | 090 29 25.30 W |
| True azimuth (°) | 40.70 | 220.79 |
| Vertical angle (°) | -0.10 | -0.10 |
| Elevation (ft) | 0.00 | 0.00 |
| Antenna model | DA8-59A(P) (TR) | PL8-59 (TR) |
| Antenna gain (dBi) | 41.60 | 41.60 |
| Antenna height (ft) | 95.00 | 94.00 |
| TX line model | EWP52 | EWP52 |
| TX line unit loss (dB/100 ft) | 1.16 | 1.16 |
| TX line length (ft) | 100.00 | 100.00 |
| TX line loss (dB) | 1.16 | 1.16 |
| Connector loss (dB) | 0.25 | 0.25 |
| Antenna model | DA6-59A(p) (DR) | DA6-59A(p) (DR) |
| Antenna gain (dBi) | 39.00 | 39.00 |
| Antenna height (ft) | 53.00 | 72.00 |
| TX line model | EWP52 | EWP52 |
| TX line unit loss (dB/100 ft) | 1.16 | 1.16 |
| TX line length (ft) | 235.00 | 150.00 |
| TX line loss (dB) | 2.72 | 1.74 |
| Connector loss (dB) | 0.25 | 0.25 |
| Frequency (MHz) | 6204.00 | |
| Polarization | Horizontal | |
| Path length (mi) | 17.65 | |
| Free space loss (dB) | 137.39 | |
| Main net path loss (dB) | 59.85 | 59.85 |
| Diversity net path loss (dB) | 64.01 | 62.43 |
| Radio model | 95MPR61-L1024A60-452 | 95MPR61-L1024A60-452 |
| Emission designator | 60M0D7W | 60M0D7W |
| TX channel assignments | 6330.665H | 6078.625H |
| Maximum receive signal (dBm) | -22.00 | -22.00 |
| SD improvement factor | 20.59 | 8.17 |

| | TX power (dBm) | | RX threshold level (dBm) | | EIRP (dBm) | | Receive signal (dBm) | | Thermal fade margin (dB) | | Flat fade margin - multipath (dB) | |
|-----------------|----------------|--------------|--------------------------|---------------|--------------|--------------|----------------------|---------------|--------------------------|--------------|-----------------------------------|--------------|
| 1024 452 | 31.50 | 31.50 | -59.00 | -59.00 | 71.69 | 71.09 | -28.35 | -28.35 | 30.65 | 30.65 | 30.65 | 30.65 |
| 512 411 | 31.50 | 31.50 | -62.50 | -62.50 | 71.69 | 71.09 | -28.35 | -28.35 | 34.15 | 34.15 | 34.15 | 34.15 |
| 256 363 | 32.50 | 32.50 | -65.50 | -65.50 | 72.69 | 72.09 | -27.35 | -27.35 | 38.15 | 38.15 | 38.15 | 38.15 |
| 128 318 | 32.50 | 32.50 | -68.50 | -68.50 | 72.69 | 72.09 | -27.35 | -27.35 | 41.15 | 41.15 | 41.15 | 41.15 |
| 64 267 | 32.50 | 32.50 | -71.25 | -71.25 | 72.69 | 72.09 | -27.35 | -27.35 | 43.90 | 43.90 | 43.90 | 43.90 |
| 32 207 | 32.50 | 32.50 | -74.25 | -74.25 | 72.69 | 72.09 | -27.35 | -27.35 | 46.90 | 46.90 | 46.90 | 46.90 |
| 16 167 | 32.50 | 32.50 | -77.50 | -77.50 | 72.69 | 72.09 | -27.35 | -27.35 | 50.15 | 50.15 | 50.15 | 50.15 |
| 4 84 | 32.50 | 32.50 | -88.00 | -88.00 | 72.69 | 72.09 | -27.35 | -27.35 | 60.65 | 60.65 | 60.65 | 60.65 |

| | Worst month multipath | | Annual multipath | | Annual rain | | Total annual (2 way) | Time in mode (2 way) |
|-----------------|-----------------------|----------------|------------------|----------------|-------------|--|----------------------|----------------------|
| 1024 452 | 99.9977 | 99.9942 | 99.9992 | 99.9980 | | | 99.9972 | 99.9972 |
| 512 411 | 99.9995 | 99.9988 | 99.9998 | 99.9996 | | | 99.9994 | 0.0023 |
| 256 363 | 99.9999 | 99.9998 | 99.9999 | 99.9999 | | | 99.9999 | 0.0005 |
| 128 318 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0001 |
| 64 267 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0000 |
| 32 207 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0000 |
| 16 167 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0000 |
| 4 84 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0000 |

Multipath fading method - Vigants - Barnett

Interferig Transmitter at 5 miles from ST100 (Victim Receiver)



| | ST100 | ST52A |
|-------------------------------|----------------------|----------------------|
| Latitude | 28 40 24.80 N | 28 52 03.80 N |
| Longitude | 090 40 48.80 W | 090 29 25.30 W |
| True azimuth (°) | 40.70 | 220.79 |
| Vertical angle (°) | -0.10 | -0.10 |
| Elevation (ft) | 0.00 | 0.00 |
| Antenna model | DA8-59A(P) (TR) | PL8-59 (TR) |
| Antenna gain (dBi) | 41.60 | 41.60 |
| Antenna height (ft) | 95.00 | 94.00 |
| TX line model | EWP52 | EWP52 |
| TX line unit loss (dB/100 ft) | 1.16 | 1.16 |
| TX line length (ft) | 100.00 | 100.00 |
| TX line loss (dB) | 1.16 | 1.16 |
| Connector loss (dB) | 0.25 | 0.25 |
| Antenna model | DA6-59A(p) (DR) | DA6-59A(p) (DR) |
| Antenna gain (dBi) | 39.00 | 39.00 |
| Antenna height (ft) | 53.00 | 72.00 |
| TX line model | EWP52 | EWP52 |
| TX line unit loss (dB/100 ft) | 1.16 | 1.16 |
| TX line length (ft) | 235.00 | 150.00 |
| TX line loss (dB) | 2.72 | 1.74 |
| Connector loss (dB) | 0.25 | 0.25 |
| Frequency (MHz) | 6204.00 | |
| Polarization | Horizontal | |
| Path length (mi) | 17.65 | |
| Free space loss (dB) | 137.39 | |
| Main net path loss (dB) | 59.85 | 59.85 |
| Diversity net path loss (dB) | 64.01 | 62.43 |
| Radio model | 95MPR61-L1024A60-452 | 95MPR61-L1024A60-452 |
| Emission designator | 60M0D7W | 60M0D7W |
| TX channel assignments | 6330.665H | 6078.625H |
| Maximum receive signal (dBm) | -22.00 | -22.00 |
| SD improvement factor | 1.00 | 8.17 |

| | TX power (dBm) | | RX threshold level (dBm) | | EIRP (dBm) | | Receive signal (dBm) | | Thermal fade margin (dB) | | Flat fade margin - multipath (dB) | |
|-----------------|----------------|--------------|--------------------------|---------------|--------------|--------------|----------------------|---------------|--------------------------|--------------|-----------------------------------|--------------|
| 1024 452 | 31.50 | 31.50 | -59.00 | -59.00 | 71.69 | 71.09 | -28.35 | -28.35 | 30.65 | 30.65 | 4.13 | 30.65 |
| 512 411 | 31.50 | 31.50 | -62.50 | -62.50 | 71.69 | 71.09 | -28.35 | -28.35 | 34.15 | 34.15 | 7.63 | 34.15 |
| 256 363 | 32.50 | 32.50 | -65.50 | -65.50 | 72.69 | 72.09 | -27.35 | -27.35 | 38.15 | 38.15 | 11.63 | 38.15 |
| 128 318 | 32.50 | 32.50 | -68.50 | -68.50 | 72.69 | 72.09 | -27.35 | -27.35 | 41.15 | 41.15 | 14.63 | 41.15 |
| 64 267 | 32.50 | 32.50 | -71.25 | -71.25 | 72.69 | 72.09 | -27.35 | -27.35 | 43.90 | 43.90 | 17.38 | 43.90 |
| 32 207 | 32.50 | 32.50 | -74.25 | -74.25 | 72.69 | 72.09 | -27.35 | -27.35 | 46.90 | 46.90 | 20.38 | 46.90 |
| 16 167 | 32.50 | 32.50 | -77.50 | -77.50 | 72.69 | 72.09 | -27.35 | -27.35 | 50.15 | 50.15 | 23.63 | 50.15 |
| 4 84 | 32.50 | 32.50 | -88.00 | -88.00 | 72.69 | 72.09 | -27.35 | -27.35 | 60.65 | 60.65 | 34.13 | 60.65 |

| | Worst month multipath | | Annual multipath | | Annual rain | | Total annual (2 way) | Time in mode (2 way) |
|-----------------|-----------------------|----------------|------------------|----------------|-------------|--|----------------------|----------------------|
| 1024 452 | 80.2111 | 99.9942 | 93.0739 | 99.9980 | | | 93.0719 | 93.0719 |
| 512 411 | 91.1606 | 99.9988 | 96.9062 | 99.9996 | | | 96.9058 | 3.8340 |
| 256 363 | 96.4810 | 99.9998 | 98.7683 | 99.9999 | | | 98.7683 | 1.8625 |
| 128 318 | 98.2363 | 99.9999 | 99.3827 | 99.9999 | | | 99.3827 | 0.6144 |
| 64 267 | 99.0637 | 99.9999 | 99.6723 | 99.9999 | | | 99.6723 | 0.2896 |
| 32 207 | 99.7414 | 99.9999 | 99.9095 | 99.9999 | | | 99.9095 | 0.2372 |
| 16 167 | 99.9421 | 99.9999 | 99.9797 | 99.9999 | | | 99.9797 | 0.0703 |
| 4 84 | 99.9995 | 99.9999 | 99.9998 | 99.9999 | | | 99.9998 | 0.0201 |

Multipath fading method - Vigants - Barnett

Interferig Transmitter at 10 miles from ST100 (Victim Receiver)



| | ST100 | ST 52A |
|-------------------------------|----------------------|----------------------|
| Latitude | 28 40 24.80 N | 28 52 03.80 N |
| Longitude | 090 40 48.80 W | 090 29 25.30 W |
| True azimuth (°) | 40.70 | 220.79 |
| Vertical angle (°) | -0.10 | -0.10 |
| Elevation (ft) | 0.00 | 0.00 |
| Antenna model | DA8-59A(P) (TR) | PL8-59 (TR) |
| Antenna gain (dBi) | 41.60 | 41.60 |
| Antenna height (ft) | 95.00 | 94.00 |
| TX line model | EWP52 | EWP52 |
| TX line unit loss (dB/100 ft) | 1.16 | 1.16 |
| TX line length (ft) | 100.00 | 100.00 |
| TX line loss (dB) | 1.16 | 1.16 |
| Connector loss (dB) | 0.25 | 0.25 |
| Antenna model | DA6-59A(p) (DR) | DA6-59A(p) (DR) |
| Antenna gain (dBi) | 39.00 | 39.00 |
| Antenna height (ft) | 53.00 | 72.00 |
| TX line model | EWP52 | EWP52 |
| TX line unit loss (dB/100 ft) | 1.16 | 1.16 |
| TX line length (ft) | 235.00 | 150.00 |
| TX line loss (dB) | 2.72 | 1.74 |
| Connector loss (dB) | 0.25 | 0.25 |
| Frequency (MHz) | 6204.00 | |
| Polarization | Horizontal | |
| Path length (mi) | 17.65 | |
| Free space loss (dB) | 137.39 | |
| Main net path loss (dB) | 59.85 | 59.85 |
| Diversity net path loss (dB) | 64.01 | 62.43 |
| Radio model | 95MPR61-L1024A60-452 | 95MPR61-L1024A60-452 |
| Emission designator | 60M0D7W | 60M0D7W |
| TX channel assignments | 6330.665H | 6078.625H |
| Maximum receive signal (dBm) | -22.00 | -22.00 |
| SD improvement factor | 1.00 | 8.17 |

| | TX power (dBm) | | RX threshold level (dBm) | | EIRP (dBm) | | Receive signal (dBm) | | Thermal fade margin (dB) | | Flat fade margin - multipath (dB) | |
|-----------------|----------------|--------------|--------------------------|---------------|--------------|--------------|----------------------|---------------|--------------------------|--------------|-----------------------------------|--------------|
| 1024 452 | 31.50 | 31.50 | -59.00 | -59.00 | 71.69 | 71.09 | -28.35 | -28.35 | 30.65 | 30.65 | 12.21 | 30.65 |
| 512 411 | 31.50 | 31.50 | -62.50 | -62.50 | 71.69 | 71.09 | -28.35 | -28.35 | 34.15 | 34.15 | 15.71 | 34.15 |
| 256 363 | 32.50 | 32.50 | -65.50 | -65.50 | 72.69 | 72.09 | -27.35 | -27.35 | 38.15 | 38.15 | 19.71 | 38.15 |
| 128 318 | 32.50 | 32.50 | -68.50 | -68.50 | 72.69 | 72.09 | -27.35 | -27.35 | 41.15 | 41.15 | 22.71 | 41.15 |
| 64 267 | 32.50 | 32.50 | -71.25 | -71.25 | 72.69 | 72.09 | -27.35 | -27.35 | 43.90 | 43.90 | 25.46 | 43.90 |
| 32 207 | 32.50 | 32.50 | -74.25 | -74.25 | 72.69 | 72.09 | -27.35 | -27.35 | 46.90 | 46.90 | 28.46 | 46.90 |
| 16 167 | 32.50 | 32.50 | -77.50 | -77.50 | 72.69 | 72.09 | -27.35 | -27.35 | 50.15 | 50.15 | 31.71 | 50.15 |
| 4 84 | 32.50 | 32.50 | -88.00 | -88.00 | 72.69 | 72.09 | -27.35 | -27.35 | 60.65 | 60.65 | 42.21 | 60.65 |

| | Worst month multipath | | Annual multipath | | Annual rain | | Total annual (2 way) | Time in mode (2 way) |
|-----------------|-----------------------|----------------|------------------|----------------|-------------|--|----------------------|----------------------|
| 1024 452 | 96.9215 | 99.9942 | 98.9225 | 99.9980 | | | 98.9205 | 98.9205 |
| 512 411 | 98.6249 | 99.9988 | 99.5187 | 99.9996 | | | 99.5183 | 0.5978 |
| 256 363 | 99.6480 | 99.9998 | 99.8768 | 99.9999 | | | 99.8767 | 0.3584 |
| 128 318 | 99.9116 | 99.9999 | 99.9691 | 99.9999 | | | 99.9690 | 0.0923 |
| 64 267 | 99.9751 | 99.9999 | 99.9913 | 99.9999 | | | 99.9913 | 0.0222 |
| 32 207 | 99.9937 | 99.9999 | 99.9978 | 99.9999 | | | 99.9978 | 0.0065 |
| 16 167 | 99.9986 | 99.9999 | 99.9995 | 99.9999 | | | 99.9995 | 0.0017 |
| 4 84 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0005 |

Multipath fading method - Vigants - Barnett

Interferig Transmitter at 30 miles from ST100 (Victim Receiver)

| | ST100 | ST52A |
|-------------------------------|----------------------|----------------------|
| Latitude | 28 40 24.80 N | 28 52 03.80 N |
| Longitude | 090 40 48.80 W | 090 29 25.30 W |
| True azimuth (°) | 40.70 | 220.79 |
| Vertical angle (°) | -0.10 | -0.10 |
| Elevation (ft) | 0.00 | 0.00 |
| Antenna model | DA8-59A(P) (TR) | PL8-59 (TR) |
| Antenna gain (dBi) | 41.60 | 41.60 |
| Antenna height (ft) | 95.00 | 94.00 |
| TX line model | EWP52 | EWP52 |
| TX line unit loss (dB/100 ft) | 1.16 | 1.16 |
| TX line length (ft) | 100.00 | 100.00 |
| TX line loss (dB) | 1.16 | 1.16 |
| Connector loss (dB) | 0.25 | 0.25 |
| Antenna model | DA6-59A(p) (DR) | DA6-59A(p) (DR) |
| Antenna gain (dBi) | 39.00 | 39.00 |
| Antenna height (ft) | 53.00 | 72.00 |
| TX line model | EWP52 | EWP52 |
| TX line unit loss (dB/100 ft) | 1.16 | 1.16 |
| TX line length (ft) | 235.00 | 150.00 |
| TX line loss (dB) | 2.72 | 1.74 |
| Connector loss (dB) | 0.25 | 0.25 |
| Frequency (MHz) | 6204.00 | |
| Polarization | Horizontal | |
| Path length (mi) | 17.65 | |
| Free space loss (dB) | 137.39 | |
| Main net path loss (dB) | 59.85 | 59.85 |
| Diversity net path loss (dB) | 64.01 | 62.43 |
| Radio model | 95MPR61-L1024A60-452 | 95MPR61-L1024A60-452 |
| Emission designator | 60M0D7W | 60M0D7W |
| TX channel assignments | 6330.665H | 6078.625H |
| Maximum receive signal (dBm) | -22.00 | -22.00 |
| SD improvement factor | 9.42 | 8.17 |

| | TX power (dBm) | | RX threshold level (dBm) | | EIRP (dBm) | | Receive signal (dBm) | | Thermal fade margin (dB) | | Flat fade margin - multipath (dB) | |
|-----------------|----------------|--------------|--------------------------|---------------|--------------|--------------|----------------------|---------------|--------------------------|--------------|-----------------------------------|--------------|
| 1024 452 | 31.50 | 31.50 | -59.00 | -59.00 | 71.69 | 71.09 | -28.35 | -28.35 | 30.65 | 30.65 | 27.39 | 30.65 |
| 512 411 | 31.50 | 31.50 | -62.50 | -62.50 | 71.69 | 71.09 | -28.35 | -28.35 | 34.15 | 34.15 | 30.89 | 34.15 |
| 256 363 | 32.50 | 32.50 | -65.50 | -65.50 | 72.69 | 72.09 | -27.35 | -27.35 | 38.15 | 38.15 | 34.89 | 38.15 |
| 128 318 | 32.50 | 32.50 | -68.50 | -68.50 | 72.69 | 72.09 | -27.35 | -27.35 | 41.15 | 41.15 | 37.89 | 41.15 |
| 64 267 | 32.50 | 32.50 | -71.25 | -71.25 | 72.69 | 72.09 | -27.35 | -27.35 | 43.90 | 43.90 | 40.64 | 43.90 |
| 32 207 | 32.50 | 32.50 | -74.25 | -74.25 | 72.69 | 72.09 | -27.35 | -27.35 | 46.90 | 46.90 | 43.64 | 46.90 |
| 16 167 | 32.50 | 32.50 | -77.50 | -77.50 | 72.69 | 72.09 | -27.35 | -27.35 | 50.15 | 50.15 | 46.89 | 50.15 |
| 4 84 | 32.50 | 32.50 | -88.00 | -88.00 | 72.69 | 72.09 | -27.35 | -27.35 | 60.65 | 60.65 | 57.39 | 60.65 |

| | Worst month multipath | | Annual multipath | | Annual rain | | Total annual (2 way) | Time in mode (2 way) |
|-----------------|-----------------------|----------------|------------------|----------------|-------------|--|----------------------|----------------------|
| 1024 452 | 99.9898 | 99.9942 | 99.9964 | 99.9980 | | | 99.9944 | 99.9944 |
| 512 411 | 99.9979 | 99.9988 | 99.9993 | 99.9996 | | | 99.9989 | 0.0045 |
| 256 363 | 99.9997 | 99.9998 | 99.9999 | 99.9999 | | | 99.9998 | 0.0009 |
| 128 318 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0001 |
| 64 267 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0000 |
| 32 207 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0000 |
| 16 167 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0000 |
| 4 84 | 99.9999 | 99.9999 | 99.9999 | 99.9999 | | | 99.9999 | 0.0000 |

Multipath fading method - Vigants - Barnett